

**FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT**



U. S. Department of Energy

National Energy Technology Laboratory

Solid State Lighting Product Development III

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Application Due Date:	09/12/2006 at 8:00:00 PM Eastern Time

DE-PS26-06NT42832
Solid State Lighting Product Development III
Amendment 001

The purpose of this amendment is to extend the application due date and incorporate the “EXCEPTIONAL CIRCUMSTANCES” article under PART VII – OTHER INFORMATION. All changes have been incorporated into the revised Funding Opportunity Announcement attached to this amendment. The specific changes made as a result of this amendment are as follows:

1. Under **PART IV – APPLICATION AND SUBMISSION INFORMATION, Article E. – Submission Dates and Times**, specifically **2. Application Due Date**, the due date for applications under this funding opportunity announcement is hereby extended by one (1) week, through September 12, 2006. The revised due date and time for applications received under this funding opportunity announcement is September 12, 2006, not later than 8:00 PM Eastern Time.
2. Under **PART VII – OTHER INFORMATION**, the following is incorporated as Article I EXCEPTIONAL CIRCUMSTANCES. **This article is applicable to Program Areas of Interest 1 and 2 only:**

“The Exceptional Circumstances Determination for the Solid State Lighting Program ([http://www.netl.doe.gov/ssl/PDFs/SSL_Determination - Signed June 2005_1.pdf](http://www.netl.doe.gov/ssl/PDFs/SSL_Determination_-_Signed_June_2005_1.pdf)) imposes a United States manufacture requirement on the recipients of SSL Product Development cooperative agreements resulting from this Announcement. Specifically, the Determination requires that any entity having the right to use or sell any subject invention under one of the cooperative agreements in the United States and/or any other country -including the product developer--must agree that any products embodying the subject invention or produced through the use of the subject invention will be substantially manufactured in the United States. Any waiver of this requirement must be approved in writing by the Department of Energy in advance of foreign manufacture.”

No other changes are made to the Funding Opportunity Announcement by way of this amendment.

End of Amendment 001

NOTE: NEW REQUIREMENTS FOR GRANTS.GOV

Where to Submit

Applications must be submitted through Grants.gov to be considered for award. You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately. Remember you have to update your CCR registration annually. If you have any questions about your registration, you should contact the Grants.gov Helpdesk at 1-800-518-4726 to verify that you are still registered in Grants.gov.

Registration Requirements

There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See <http://www.grants.gov/GetStarted>. Use the Grants.gov Organization Registration Checklist at <http://www.grants.gov/assets/OrganizationRegCheck.doc> to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

IMPORTANT NOTICE TO POTENTIAL APPLICANTS: When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e. Grants.gov registration).

Questions

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. Part VII of this announcement explains how to submit other questions to the Department of Energy (DOE).

Application Receipt Notices

After an application is submitted, the Authorized Organization Representative (AOR) will receive a series of five e-mails. It is extremely important that the AOR watch for and save each of the emails. It may take up to two (2) business days from application submission to receipt of email Number 2. You will know that your application has reached DOE when the AOR receives email Number 5. You will need the Submission Receipt Number (email Number 1) to track a submission. The titles of the five e-mails are:

- Number 1 – Grants.gov Submission Receipt Number
- Number 2 – Grants.gov Submission Validation Receipt for Application Number
- Number 3 – Grants.gov Grantor Agency Retrieval Receipt for Application Number
- Number 4 – Grants.gov Agency Tracking Number Assignment for Application Number
- Number 5 – DOE e-Center Grant Application Received

The last email will contain instructions for the AOR to register with the DOE e-Center. If the AOR is already registered with the DOE e-Center, the title of the last email changes to:

Number 5 – DOE e-Center Grant Application Received and Matched

This email will contain the direct link to the application in IIPS. The AOR will need to enter their DOE e-Center user id and password to access the application.

VERY IMPORTANT – Download PureEdge Viewer

In order to download the application package, you will need to install PureEdge Viewer. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following web site:

<http://www.grants.gov/DownloadViewer>.

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PART I – FUNDING OPPORTUNITY DESCRIPTION

A. SUMMARY

Solid-State Lighting

Goal:

By 2025, develop advanced solid-state lighting technologies that compared to conventional lighting technologies, are much more energy efficient, longer lasting, and cost competitive by targeting a product system efficiency of 50 percent with lighting that accurately reproduces sunlight spectrum.

The Department of Energy (DOE), National Energy Technology Laboratory (NETL), on behalf of the Office of Energy Efficiency and Renewable Energy's (EERE's) Building Technologies Program (BTP), is seeking applications for product development in the Solid-State Lighting (SSL) Program and for the production and distribution of SSL technical information to the market.

DOE has set aggressive and ambitious goals for SSL Research and Development: By 2025, to develop advanced SSL technologies that, compared to conventional lighting technologies, are much more energy efficient, longer lasting,

and cost-competitive.

While the current generation of SSL products are commercially viable, they are most often used in markets that do not produce the large energy conservation objectives sought by DOE. Moreover, the technical challenges that impede penetration into mainstream general illumination markets are complex and may require the combined resources of many researchers and perhaps, the unique research tools found only at a limited number of universities, National Laboratories and research institutions. It may be difficult to overcome these critical technical challenges without a focused Government initiative. Partly, this is because the high payoffs sought may be judged too risky for industry to undertake alone. Thus, the collaborations sought under this Funding Opportunity Announcement (FOA) will "buy down" or reduce the level of technical risk by providing significant financial resources. In addition, applications for the efficient production and distribution of SSL technical information that would be of value to the market among key target market sectors, such as electric utilities, state energy organizations, builders, retailers, and architectural firms, are being sought under this FOA.

B. BACKGROUND INFORMATION

The lighting industry is nearly 100 years old and is often characterized as a mature industry. The DOE's BTP selected lighting as one of the principle target markets for the development of more efficient technologies since it represents one-fifth of the national electrical consumption. The DOE has provided assistance over the past several years with significant effort invested by industry, academia and Government; the prevailing theme that has surfaced repeatedly is that the promise of SSL will only be produced through a focused and concentrated effort between the stakeholders.

Today, the lighting industry in North America is worth approximately \$45 Billion in sales annually. Of this amount, approximately \$12 Billion is associated with lamps while the remaining sales are divided between fixtures, components (including ballasts and controls) and services such as design and maintenance. High brightness Light Emitting Diode (LED) sales, a popular product thought by many to be the nearest term solution to SSL, is a \$1 to \$2 Billion business with exponential growth prospects.

Electricity consumed for lighting represents about 8.2 Quads or nearly 8.5 % of all the primary energy consumed annually by the Nation. Lighting also consumes 30% of all electricity in buildings.

To address these issues and to advance energy conservation in lighting in US Buildings, the DOE's BTP maintains a Lighting Research and Development (LR&D) activity. Key to the objectives of this activity is its mission statement:

"To increase end-use efficiency in buildings by aggressively researching new and evolving lighting technologies, in close collaboration with partners, to develop viable methodologies that have the technical potential to conserve 50% of electric

lighting consumption by 2025."

The DOE envisions a LR&D Program that works together with the SSL industry to meet the program's goal by the year 2025. Critical to this LR&D Program are seven important aspects:

- Emphasize Competition
- Cost (and Risk) Sharing
- Partners Involved in Planning and Funding
- Targeted Research for Focused Need
- Innovative Intellectual Property (IP) Provisions
- Open Information and Process
- Success Determined by Milestones Met and Ultimately Energy Efficient, Long-life and Cost-Competitive Products Developed

C. FUNDING OPPORTUNITY OBJECTIVES

The intent of this FOA is twofold. The DOE is seeking applications from:

1. Industrial Organizations that sufficiently address product development; and
2. Organizations that adequately propose to create and disseminate SSL material.

Product development is the systematic use of knowledge gained from basic and applied research to develop or improve commercially viable materials, devices, or systems. Technical activities are focused on a targeted market application with fully defined price, efficacy, and other performance parameters necessary for success of the proposed product. Product development encompasses the technical activities of product concept modeling through the development of test models and field ready prototypes. In some cases, product development may include "focused-short-term" applied research, but its relevance to a specific product must be clearly identified. Like previous FOA's in the SSL series, this one also seeks to advance and promote the collaborative atmosphere of the LR&D SSL program to identify potential product concepts; and incorporate into product supportive technologies that are novel, innovative and groundbreaking or that fill technology voids or that otherwise represent a technological advancement of SSL products.

The second objective of this FOA is to establish a technical information network for efficient sharing of SSL technical information. The goal of this network will be to increase the level of understanding of SSL technology, performance, and appropriate applications within key residential and commercial market sectors. To help accomplish this goal, DOE intends to enter into cooperative agreements with organizations who are experienced at developing and delivering technical information on energy-efficient technologies, and who have an interest in providing SSL technical information to the customers and clients they serve.

D. PROGRAM AREAS OF INTEREST

There are three specific Program Areas of Interest for this FOA. Applicants are cautioned that this FOA is a Master Announcement and that each Program Area of Interest has its own specific number for submission of applications. **Applications cannot be submitted under the Master Announcement.**

Applicants must select and target only one (1) Program Area of Interest per application and must not submit multiple applications for the same project. If the same applicant submits multiple applications with identical titles, only the application with the latest submitted time stamp which is received prior to the due date will be considered for review. A separate application must be submitted for each technology or technical approach targeted under a single Program Area of Interest.

The first two Program Areas of Interest target technical innovations in Light Emitting Diodes (LED) and in Organic Light Emitting Diodes (OLED). The objective of the first two Program Areas of Interest is to develop energy saving products that will reduce the total national lighting energy consumption through SSL Technology. DOE's primary metric for these technical projects is lumens per Watt (LPW). The third Program Area of Interest seeks applications for the efficient production and distribution of SSL technical information that would be of value to the market among key target market sectors, such as electric utilities, state energy organizations, builders, retailers, and architectural firms. In addition to a description of demonstrated experience and capability to perform the requested effort, DOE seeks applications that identify new and attractive ideas for assembling and distributing technical information to target recipients.

Descriptive information on each of the three Program Areas of Interest is provided in the following paragraphs:

LED & OLED Product Development

The DOE's Building Technologies Program (BTP) has hosted three technical workshops aimed at identification and prioritization of the research opportunities. These workshops have been used to help focus the resources available to this activity on technical topics that will produce the most impact early. Complete reports for these workshops are available at the DOE's web site for SSL at <http://www.netl.doe.gov/ssl/>. The SSL research projects currently funded by DOE can be found in the SSL Project Portfolio. Each project profile in the portfolio includes a brief technical description as well as information about the project partners, funding, and time frame. For more information on the Portfolio please refer to <http://www.netl.doe.gov/ssl/project.html>.

The current version of DOE's Multi-Year Program Plan identifies a number of very specific product development milestones. For 2008 these milestones are: (1) An LED lighting product on the market with an efficacy >80lm/W, cost <\$25/klm, and 70% lumen maintenance for >50khrs; and (2) an OLED niche product on the market with an efficacy of ~25lm/W, cost <\$100/klm, and 50% lumen maintenance for >5000 hours.

This FOA targets lighting system products or luminaires that are consistent with these milestones as well as other target performance objectives described below.

Program Area of Interest 1 - LED Product Development - Advanced Architectures and Designs for High Power Conversion Efficiency Emitters in conjunction with LED packages and packaging materials (Tasks 2.1.4, 2.2.2) (DE-PS26-06NT42832-01)

With any quality SSL product development process, the integration of multiple technologies is needed to solve various issues resulting in a long-lived product with efficiency in excess of 110 LPW by 2009, leading to meaningful energy savings. For this Program Area of Interest, two subtasks from the SSL Program Planning Workshop Report February 3-4, 2005¹ are being united to develop a SSL product that will satisfy the performance and cost objectives of the DOE. These two subtasks consist of the following:

2.1.4 Advanced Architectures and Designs for High Power Conversion Efficiency Emitters, and

2.2.2 LED packages and packaging materials.

Applications do not necessarily have to fully address both subtasks as long as the proposed white LED product demonstrates the potential to improve the efficiency of an LED beyond the current efficacy targets listed in Figure 1.1.

Applications are being sought that demonstrate advancements in architectures and designs for high power emitters to optimize both the electrical transport, thermal and optical properties. The entire system needs to be addressed including all aspects from the chip to the luminaire if sizeable efficiency gains are going to be realized. An opportunity exists to make a significant impact to the efficiency of the product by increasing the external quantum efficiency (EQE) of the chip above the 2005 level of 30% and eventually reaching or exceeding the 2015 target of 81%.² At the chip level, topics could include, but are not limited to, photonic crystals, micro-cavities, quantum dots, surface roughening, chip shaping, chip scaling or device thinning. Advanced architecture approaches could also target the applications that use commercially available LEDs to increase the power capability through novel multi-color chip arrays in a single package. Innovations in this area are key to making substantial energy savings possible with SSL technology.

¹ For more information on the 2nd SSL Program Planning Workshop Report February 3-4, 2005 please refer to: http://www.netl.doe.gov/ssl/PDFs/DOE_SSL_Workshop_Report_Feb2005.pdf

² Solid-State Lighting Research and Development Portfolio Multi-Year Program Plan FY'07-FY'12. Available at: <http://www.netl.doe.gov/ssl/PDFs/SSLMultiYearPlan.pdf>

Packaging technology is also a critical aspect in achieving efficient, high brightness, long life and low cost light sources. The heat generated from LEDs may reduce efficacy and degrade device reliability. For lighting, the ability to densely package LEDs may be important to achieve an efficient product with a total lumen output high enough to replace conventional sources. Application aspects should focus on innovative LED packaging technology for single LED packages and LED arrays using techniques such as novel electrical contacts, heat dissipation techniques, packaging materials and thermal designs that can effectively remove the intense heat that is generated from high brightness LEDs in compact configurations.

Successful applications will demonstrate the potential to exceed the device performance goals and projections of price described in Figure and Table 1.1 for the year the project will conclude. The efficiency, life expectancy and cost of the complete system must all be considered.

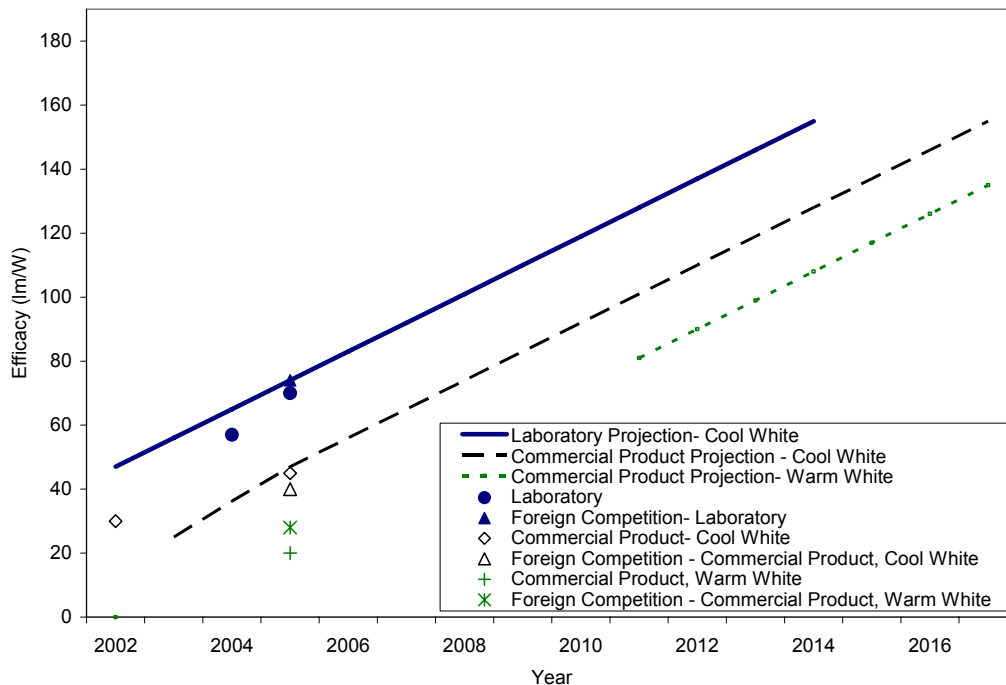


Figure 1.1 White-Light LED Device Efficacy Targets, Laboratory and Commercial

LED Summary Table				
Year	Efficacy LPW (Lab)	Efficacy LPW (Comm)	Life (khrs)	Cost (\$/klm)
2007	92	65	43	35
2008	101	74	50	25
2009	110	83	57	19
2010	119	92	63	14
2011	128	101	70	10
2012	137	110	77	7
2013	146	119	83	5
2014	155	128	90	4
2015	164	137	97	3

Table 1.1 Laboratory Device Available White-Light LED System Efficacy Estimates

Table 1.1 presents the projected individual performance of white-light. The cost estimates were developed in consultation with the Next Generation Lighting Industry Alliance (NGLIA) Technical Committee, and represent the average performance of 1-3 watt white-light LED devices driven at 350 mA (excluding driver or fixture costs). The projections are based on white-light LED chips operating at a CCT of 4100K and a CRI of 80 or higher.

For this FOA, the DOE is seeking only products that emit light, consequently, manufacturers of enabling products, such as encapsulants or thermal materials, are encouraged to partner with SSL manufacturers to develop light emitting products which have the potential of significant gains in device efficiency.

Program Area of Interest 2 - OLED Product Development - Implementing Strategies for Improved Light Extraction and Manipulation along with Encapsulation and Packaging Techniques (Tasks 4.2.1, 4.3.1) (DE-PS26-06NT42832-02)

Under Program Area of Interest 2, applications are being sought that will produce or modify a light emitting product that will significantly advance the general illumination efficacy targets listed in Figure 1.2, through the research and development identified in the following high-priority subtasks.

Successful applications will likely represent an integration of innovative approaches and will build upon several contributing technologies. The utility of these contributing technologies must be proven either by reference to prior work or by other suitable documentation. Applications that are dependant upon unproven architectures or materials systems and that seek to demonstrate the proposed approach in theory or on a laboratory scale will not be considered under this product development Program Area of Interest.

For this Program Area of Interest, two subtasks from the SSL Program Planning Workshop Report February 3-4, 2005³ are being joined to design and manufacture a SSL product that will conserve energy in the general illumination market. These two subtasks consist of the following:

4.2.1 Implementing strategies for improved light extraction and manipulation, and

4.3.1 OLED encapsulation packaging for lighting applications.

An applicant's focus should be on the energy saving aspects of these subtasks *as applied to general illumination*. Therefore, a greater emphasis should be placed on the enhancement of light extraction and manipulation as opposed to OLED encapsulation packaging.

The internal quantum efficiency (IQE) of OLEDs is approaching 100% and there has been significant progress reducing the operating voltage, but the EQE is only around 30%. Clearly, there is room for significant improvement in EQE for OLEDs. The goal is to eventually achieve an EQE in the 80% range where OLED lighting technologies would be superior over conventional lighting technologies in terms of product efficacy.⁴ Innovative light extraction techniques are being sought that circumvent the limiting flat surface on the OLED thereby allowing the maximum generated light to escape. Techniques could include, but are not limited to, cavities, microlenses, surface roughening, index matched layers, etc. Developers of new extraction techniques are encouraged to team with companies with the capability of manufacturing OLEDs to create the first generation of viable OLED lighting products.

White OLED lamps and luminaires may eventually displace large area conventional illumination sources such as fluorescent lamps. However, before this vision can become a reality, several technical challenges need to be overcome. OLED devices are very susceptible to damage by environmental elements such as oxygen and water. Novel methods to improve OLED lamps and luminaires are being sought that hermetically seal or passivate OLED structures to demonstrate a greatly enhanced lifetime and would allow for a low cost, high volume manufacturing process. Such innovative encapsulants must be transparent while having excellent visible light transmittance. The subject packaging approach will need to address thermal management and dissipation techniques for maximizing high quality lumen output. Heat management and dissipation are key factors limiting the OLED efficiency.

³ For more information on the 2nd SSL Program Planning Workshop Report February 3-4, 2005 please refer to: http://www.netl.doe.gov/ssl/PDFs/DOE_SSL_Workshop_Report_Feb2005.pdf

⁴ Solid-State Lighting Research and Development Portfolio Multi-Year Program Plan FY'07-FY'12. Available at: <http://www.netl.doe.gov/ssl/PDFs/SSLMultiYearPlan.pdf>

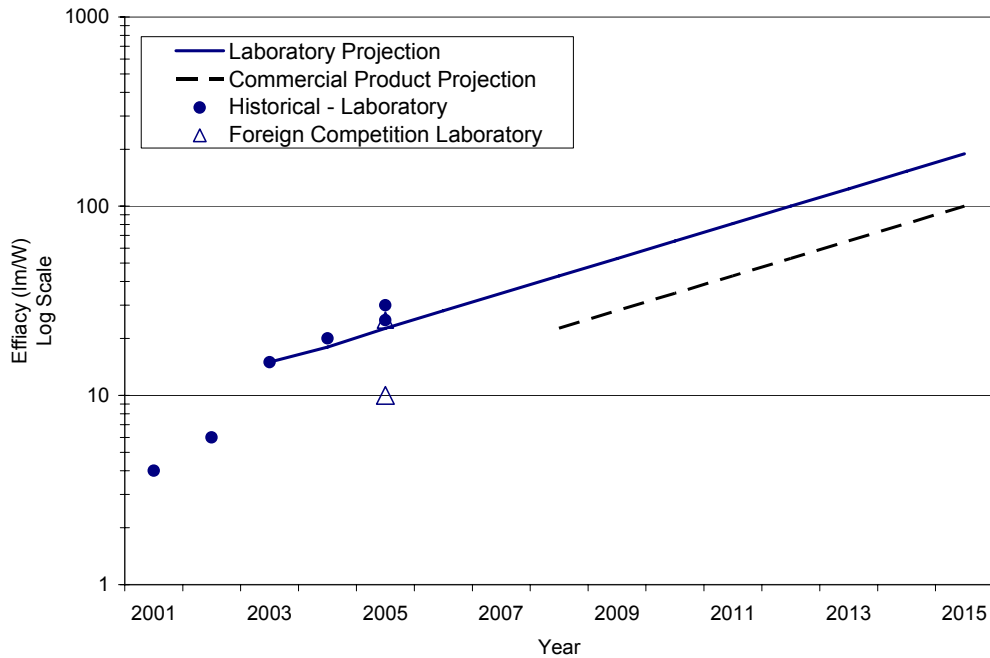


Figure 1.2 White-Light OLED Device Efficacy Targets, Laboratory and Commercial (On a logarithmic scale)

OLED Summary Table				
Year	Efficacy LPW (Lab)	Efficacy LPW (Comm)	Life (khrs)	Cost (\$/klm)
2007	35	18	4	149
2008	43	23	5	99
2009	53	28	6	67
2010	65	35	7	45
2011	81	43	7	30
2012	100	53	8	20
2013	124	65	9	13
2014	153	81	10	9
2015	189	100	11	6

Table 1.2 Laboratory Device Available White-Light OLED System Efficacy Estimates

Figure 1.2 and Table 1.2 present the projected performance of available white-light OLEDs. This data represents SSL sources projected under the accelerated investment

scenario of a recent DOE study.⁵ The cost and performance estimates were developed in consultation with industry. The projections are based on white-light OLED chips operating at a CCT of 3000K-6000K and a CRI of 80 or higher. These performance characteristics have not yet been demonstrated.

Specific performance metrics should be carefully chosen to measure progress and will be used to determine the eventual success of the project. Additionally, device improvements to the OLED lamps or luminaires need to show a clear, concise and reasonable plan as to how they will reach the performance objectives in Table 1.2 above. The efficiency, life expectancy and cost of the complete system must all be considered.

Technical Information Network

Applications are being sought for the efficient production and distribution of SSL technical information to the market. It is expected that successful applications will demonstrate prior energy efficiency program involvement and a strong background in developing and distributing technical information on energy-efficient technologies into the market.

Program Area of Interest 3 - Technical Information Network - Develop a Technical Information Network to Disseminate SSL Information to Target Markets (DE-PS26-06NT42832-03)

The DOE intends to establish an SSL technical information network to increase the level of understanding of SSL technology, performance, and appropriate applications within key target markets.

The DOE seeks applications to help produce and distribute materials relating to SSL technology, performance and applications. Awardees, coordinating with the DOE, would identify the best means for delivering SSL technical information to target markets and how best to format and package that information. Awardees would be responsible for producing information packages and for making them available for use by others in the network in both printed and electronic form. It is anticipated that materials developed as part of the SSL technical information network will be free of charge to all interested parties, and users may customize materials as appropriate.

For example, an awardee may be given responsibility for developing an information package directed toward homebuilders. Using its own understanding of the homebuilder market and technical information provided by DOE, the awardee would develop a builder information package best suited for a geographic homebuilder market being served by that awardee. The awardee would make the package available to others in the network, who could modify the package to suit their own needs. Modifications could be as simple as substituting new sponsor names and logos, or they could involve much more extensive changes, such as those needed to address unique regional market attributes.

To the extent possible, this network will utilize existing communication channels and energy efficiency programs. If a network participant is conducting outreach activities to commercial building owners and managers through periodic seminars, it would be best

⁵ Solid-State Lighting Research and Development Portfolio Multi-Year Program Plan FY'07-FY'12. Available at: <http://www.netl.doe.gov/ssl/PDFs/SSLMultiYearPlan.pdf>

to add the SSL technical information to that existing program rather than initiate an independent outreach effort.

Key target market sectors to be served by the network include:

- Retailers
- Builders and Lighting Contractors
- Consumers
- Building Owners and Managers
- Building Code Officials
- Utilities and Energy Efficiency Organizations

The nature of the information to be developed will vary by target market, and will be customized by the awardees using technical SSL information provided by the DOE, but generally will address such topics as:

- Typical and state-of-the-art SSL performance measures
- Appropriate application of SSL systems, based on the current state of the technology
- Sources for more detailed and reliable information
- News on SSL technology and product developments
- News on SSL programs and product promotions
- Case studies of successful applications for SSL
- Selected in-depth discussions of technical issues, such as color quality, thermal management, or optics
- Comparisons of SSL and conventional lighting systems
- SSL costs and cost effectiveness

Applicants to this Program Area of Interest should propose to use a variety of information channels to distribute SSL information such as: materials posted to existing websites, newsletters (electronic and printed), articles placed in journals and magazines, conference presentations, etc.

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT.

- DOE anticipates awarding cooperative agreements under this program announcement. (See Section VI.B.2 Statement of Substantial Involvement.)

B. ESTIMATED FUNDING.

- Under this announcement, approximately \$3,750,000 is expected to be available for new awards within Program Areas of Interest 1 and 2, and \$300,000 is expected to be available for new awards within Program Area of Interest 3.

C. MAXIMUM AND MINIMUM AWARD SIZE.

- Ceiling (i.e., the maximum amount for an individual award made under this announcement):
None
- Floor (i.e., the minimum amount for an individual award made under this announcement):
None

D. EXPECTED NUMBER OF AWARDS.

- Under this announcement, DOE anticipates making 2-5 awards under Program Areas of Interest 1 and 2 depending on the size of the awards. DOE anticipates making 5-7 awards under Program Area of Interest 3. However, the Government reserves the right to fund, in whole or in part, any, all, or none of the applications submitted in response to this announcement and will award that number of financial assistance instruments which serves the public purpose and is in the best interest of the Government.

E. ANTICIPATED AWARD SIZE.

- DOE anticipates that awards will not exceed \$900,000 (Federal share) per year for up to three (3) years for Program Areas of Interest 1 and 2.
- DOE anticipates that awards will not exceed \$50,000 (Federal share) per year for up to three (3) years for Program Area of Interest 3.

F. PERIOD OF PERFORMANCE.

- DOE anticipates making awards that will range from twelve (12) to thirty-six (36) months. Awards will have project and budget periods that are specific to the project and funding.

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

- All types of entities are eligible to apply, except other Federal agencies, Federally Funded Research and Development Center (FFRDC) Contractors, and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

B. COST SHARING

- For all Program Areas of Interest under this FOA, the cost share must be at least 20% of the total allowable costs (i.e., the sum of the Government share, including FFRDC contractor costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-Federal sources unless otherwise allowed by law. (See 10 CFR part 600 for the applicable cost sharing requirements.)

C. OTHER ELIGIBILITY REQUIREMENTS.

- **Federally Funded Research and Development Center (FFRDC) Contractors.** FFRDC contractors are not eligible for an award under this announcement, but they may be proposed as a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award and must not place the FFRDC contractor in direct competition with the private sector.

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization.

"Authorization is granted for the _____ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory, and will not place the laboratory in direct competition with the domestic private sector."

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

FFRDC Contractor Effort:

- The FFRDC contractor effort, in aggregate, shall not exceed 10% of the total estimated cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. The applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

PART IV – APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE.

- Application forms and instructions are available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select “Apply for Grants,” and then select “Download Application Package.” Enter the CFDA and/or the funding opportunity number located on the cover of this announcement and then follow the prompts to download the application package. **NOTE:** You will not be able to download the Application Package unless you have installed PureEdge Viewer (See: <http://www.grants.gov/DownloadViewer>).

Applicants are reminded that there are three specific Program Areas of Interest for this FOA and that each Program Area of Interest has its own specific number for submission of applications. **Applications cannot be submitted under the Master Announcement. Applicants MUST download the Application Package specific to the Program Area(s) of Interest to which they are applying.**

B. LETTER OF INTENT AND PRE-APPLICATION.

1. Letter of Intent.

- Letters of Intent are not required.

2. Pre-application.

- Pre-applications are not required.

C. CONTENT AND FORM OF APPLICATION – 424 (R&R)

You must complete the mandatory forms and any applicable optional forms (e.g., Disclosure of Lobbying Activities (SF-LLL)) in accordance with the instructions on the forms and the additional instructions below. Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.

1. **SF 424 (R&R).** Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. To activate the instructions, turn on the “Help Mode” (Icon with the pointer and question mark at the top of the form). The list of certifications and assurances referenced in Field 18 can be found on the Applicant and Recipient Page at <http://grants.pr.doe.gov> under Certification and Assurances.
2. **RESEARCH AND RELATED Other Project Information.**
Complete questions 1 through 5 and attach files. The files must comply with the following instructions:

Project Summary/Abstract (Field 6 on the Form)

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the publication. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the

potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) with font not smaller than 11 point. To attach a Project Summary/Abstract, click "Add Attachment."

Project Narrative (Field 7 on the Form)

The project narrative must not exceed **25 pages**, including cover page, table of contents, charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). **EVALUATORS WILL ONLY REVIEW THE NUMBER OF PAGES SPECIFIED IN THE PRECEDING SENTENCE.** The font must not be smaller than 11 point. Do not include any Internet addresses (URLs) that provide information necessary to review the application, because the information contained in these sites will not be reviewed. See Part VIII.D for instructions on how to mark proprietary application information. To attach a Project Narrative, click "Add Attachment."

The project narrative should provide a clear description of the work to be undertaken and how it will be accomplished. To help facilitate the review process and to ensure maximum consideration of the application's merit, the applicant should review the following elements when preparing the project narrative and must provide ALL of the specified information listed below.

The project narrative must include:

- Project Objectives. This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.
- Merit Review Criterion Discussion. This section should be formatted to address each of the merit review criterion and sub-criterion listed in Part V. A. Sufficient information is to be provided so that the reviewers will be able to evaluate the application in accordance with these criterion and sub-criterion.

FOR PROGRAM AREAS OF INTEREST 1 & 2, DOE WILL EVALUATE AND CONSIDER ONLY THOSE APPLICATIONS THAT ADDRESS SEPARATELY EACH OF THE MERIT REVIEW CRITERION AND SUB-CRITERION BELOW:

Please provide all relevant information such that the application can be evaluated properly. As a reference to ensure that applications to Program Areas of Interest 1 and 2 have captured all relevant information, please reference the checklist item suggestions illustrated in Appendix D, "Checklist Item Suggestions for Program Areas of Interest 1 and 2."

1. Technical Merit

- 1.1. Clearly define the product to be developed under this application. "Product" in this case can be a lighting system, a lamp, or some other clearly defined *marketable* technology that emits light and addresses the Program Areas of Interest in this FOA. Provide a detailed discussion of the need or problem the technology or product will address and the major issues and key risks in the development of the proposed technology. Provide a detailed discussion to validate that the proposed technology or product is technically superior to currently available products. Use Appendix A – Product Description, as a guide to identify the proposed project specifications. Typically, technical superiority will be demonstrated by efficiency (highest priority to the DOE), total light output, lifetime and color quality. Use Appendix B – Current and Target System Efficiencies, as a guide when proposing system efficiencies.
- 1.2. Give a detailed discussion of the project approach and the overall impact of successful project completion to future success in the marketplace. Identify competing technologies or products.
- 1.3. Provide a clear, complete and feasible Statement of Project Objectives (SOPO). (See the Statement of Project Objectives (SOPO) discussion for the specific format of the SOPO). Provide a detailed discussion of the proposed work in the SOPO. Provide a chart depicting the project schedule, milestones, deliverables and interrelationship of the project tasks. Supply both qualitative and quantitative milestones and performance metrics to gauge technical progress and demonstrate a progressive workplan. Describe the relevance of the milestones and their ability to demonstrate progress towards the proposed objectives. A physical product demonstration deliverable showing measurable progress should be proposed for submission directly to the SSL Project Officer for independent evaluation during each year for the duration of the project. Measurable progress toward the established goals needs to be verified. The timing of milestones and deliverables should also be such that progress against them can be evaluated at the scheduled reviews for the project.
- 1.4. Include a detailed discussion to prove the feasibility of the proposed technology or product, the scientific merit (based on sound scientific and engineering principles and demonstrated in the lab or scientific literature), and the degree to which the technology or product is innovative and unique.

2. Applicant and Participant Roles and Capabilities

- 2.1. Discuss the abilities of the applicant to successfully perform project management functions as the result of previous programs, Federal or non-Federal. Provide a detailed discussion of current corporate experience and success in similar projects resulting in successful technology development and commercialization or technology transfer to commercial product(s). If necessary, teaming between companies is encouraged to bring together technical and commercialization experience. If an applicant does not have manufacturing or marketing capability in house then they should team with an appropriate partner or partners who have these capabilities. Teaming arrangements are encouraged that bring together the strengths of multiple organizations to develop and commercialize an entire light emitting product. Teaming arrangements need to have clearly defined roles, qualitative and quantitative technical

milestones, marketing and business strategies and Intellectual Property (IP) agreements.

- 2.2. Include a detailed discussion of experience and availability of key personnel to complete the proposed project. Relative to the nature and time scale of the proposed project, identify team capabilities for both technical expertise and, if needed for the success of the project, product commercialization and/or technology transfer expertise. Identify possible shortfalls in expertise and a plan for addressing them (partnership, subcontractor, etc.). For key personnel who are not staff members of the applicant's organization, provide evidence of the availability and commitment of such personnel, consistent with their role in the proposed tasks. Describe the organizational structure for transfer of technology from the lab to manufacturing for this specific project.
 - 2.3. Supply a table listing the estimated labor hours and labor categories (e.g., project manager, principal investigator, engineering, technician, scientific, clerical) required for each task and provide totals for each project phase. Include a table showing labor hours and labor categories for any proposed subcontracting or consulting effort for each task. Discuss the rationale used to develop estimates for labor hours, labor categories, subcontracting effort, and consulting effort. Explain the purpose of the subcontract or consulting effort. Cost information is not to be included in the technical application volume.
 - 2.4. Discuss the adequacy (quality, availability and appropriateness) of facilities and equipment to accommodate the proposed project. Identify any major equipment needed for the proposed project that will be acquired during the course of the project.
3. Industrial Involvement and Commercialization Potential
- 3.1. Identify the target customer set and the sales channel for the product. Provide a discussion of the commercialization strategy for the proposed technology or product and of the intellectual property rights and/or institutional alliances to execute the commercialization strategy. The discussion should include evidence of an initial business plan and should demonstrate teaming arrangements or corporate business management support to successfully execute the commercialization strategy.
 - 3.2. Offer a detailed discussion of the viability and practicality of the proposed technology, product or information to meet the needs of the target market. Show that the product can be developed in a cost effective manner to meet the stated target price. Consider potential technical, regulatory, economic, environmental, production or other issues that may impact market success. Any variation from the price and performance projections outlined in Part I of this Announcement (reference Tables/Figures 1.1 or 1.2) must be clearly identified and explained.
 - 3.3. Describe the organizational commitment to manufacturing developed products in the United States. Give examples of current products manufactured in the U.S.
4. Energy, Environmental, and Economic Benefits
- 4.1. Provide evidence of significant energy benefits and technical performance that will be attributable to the proposed technology or product. Use the "Guide for Evaluation of

Energy Savings Potential – Solid State Lighting Research and Development,” contained in Appendix C to this Announcement, to determine the energy savings benefits derived from *the specific product and market* by this application. Applications should not neglect system aspects (i.e. driver efficiency) nor include numbers or predictions that aren’t defensible.

- 4.2. Provide evidence of significant environmental benefits attributable to the proposed technology or product. Environmental benefits include, but are not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts. Determine potential reductions in emissions of carbon dioxide from the proposed technology according to the guidelines contained in the “Guide for Evaluation of Energy Savings Potential – Solid State Lighting Research and Development,” Appendix C to this Announcement, but as applied to the proposed product and market.

FOR PROGRAM AREA OF INTEREST 3, DOE WILL EVALUATE AND CONSIDER ONLY THOSE APPLICATIONS THAT ADDRESS SEPARATELY EACH OF THE MERIT REVIEW CRITERION AND SUB-CRITERION BELOW:

1. Technical Merit

- 1.1. Provide a clear, complete and feasible Statement of Project Objectives as described below.
- 1.2. Provide a discussion of anticipated outcomes and results of the proposed project and the ability to influence key target markets with SSL Technical information.
- 1.3. Provide a description of the proposed approach (i.e., contributions to the Technical Information Network including proposed type and number of materials developed, training events hosted, information packets produced, web pages produced, papers written, etc.). Provide a discussion which clearly demonstrates the merits of the proposed project approach. Explain any areas of project uncertainty.
- 1.4. Identify each target market and the planned approach and proposed level of interaction and outreach.

2. Schedule

- 2.1. Provide a clear and concise discussion of the proposed work schedule including the proposed deliverables and anticipated due dates. The schedule should indicate the number of labor hours proposed, by quarter, to participate in bimonthly Technical Information Network conference calls and to develop the technical information products proposed.
- 2.2. Supply a timeline or Gantt chart showing when proposed tasks begin and end and the interrelationship of project tasks.

3. Applicant and Team Members Roles and Capabilities

- 3.1. Discuss the ability of the team to achieve the goals stated in the SOPO. This should include current corporate experience and success in similar projects resulting in market adoption of advanced energy technologies with the specified target markets. Outline the roles and responsibilities of each participant.
- 3.2. Discuss the abilities of the applicant to successfully perform project management functions as the result of previous programs, Federal or non-Federal. The applicant, or "Prime," is expected to perform a minimum of 50% of the effort for the proposed work.
- 3.3. Provide a breakdown of key personnel by project tasks (manpower matrix). The matrix should illustrate estimated labor hours and labor categories (e.g., project manager, principal investigator, etc.) required for each task and shall provide a rolled-up total for each period. The same should also be included for any proposed subcontracting or consulting efforts. Discuss the rationale used to develop estimates for labor hours and categories, and subcontracting/consulting efforts. Cost information is not to be included in the technical application volume.
- 3.4. Discuss experience working with electric utilities, market transformation organizations, State and local energy offices that operate energy efficiency programs.
- 3.5. Discuss the availability of facilities and equipment.

- **Statement Of Project Objectives (SOPO):**

The Department of Energy's, National Energy Technology Laboratory uses a specific format for Statement of Project Objectives in its awards. In announcements such as this one, where the Government does not provide a Statement of Project Objectives, the Applicant is to provide one, which the DOE will then use to generate the Statement of Project Objectives to be included in the award.

For Program Areas of Interest 1 and 2, the project narrative must contain a single, detailed Statement of Project Objectives that addresses how the project objectives will be met. The Statement of Project Objectives must contain a clear, concise description of all activities to be completed during project performance and follow the structure discussed below.

For Program Area of Interest 3, the project narrative should include identification of key target market(s) to be served (it does not need to address all of the DOE's planned target markets). Applications should identify and explain the existing or planned programs and projects that can leverage the proposed activities (utility sponsored, market transformation sponsored, corporate sponsored, etc.).

The Statement of Project Objectives may be released to the public by DOE in whole or in part at any time. It is therefore required that it shall not contain proprietary or confidential business information.

The Statement of Project Objectives is generally less than 3 to 4 pages in total for the proposed work. The Statement of Project Objectives is considered to be part of the Project Narrative and is therefore included in the 25 page limit.

Applicants shall prepare the Statement of Project Objectives in the following format:

TITLE OF WORK TO BE PERFORMED

(Insert the title of work to be performed. Be concise and descriptive. Avoid non-descriptive terms in the title, such as 'novel' or 'innovative.')

A. OBJECTIVES

Include one paragraph on the overall objective(s) of the work. Also, include objective(s) for each phase of the work.

B. SCOPE OF WORK

This section should not exceed one-half page and should summarize the effort and approach to achieve the objective(s) of the work for each Phase.

C. TASKS TO BE PERFORMED

Tasks, concisely written, should be provided in a logical sequence and should be divided into the phases of the project. This section provides a brief summary of the planned approach to this project.

PHASE I

Task 1.0 - (Title)

(Description)

Subtask 1.1 (Optional)

(Description)

Task 2.0 - (Title)

PHASE II (Optional)

Task 3.0 - (Title)

For Program Area of Interest 3 only, in addition to the specific task information requested above, applicants should include the following information in this section:

- Sponsoring organizations, funding levels, time period, etc.
- Target market(s) served (i.e. Retailers, Builders and Lighting Contractors, Consumers, Building Owners and Managers, Building Code Officials, and/or Utilities and Energy Efficiency Organizations)

- Geographic region(s) served.
- Delivery methods to be utilized (i.e. newsletters (electronic or print), brochures, web site(s), trade/professional meetings, conferences, training events (web-based or stand-up), etc.).
- Links to information sources, such as web sites, newsletters, brochures, used to support the target market(s).
- Coordination with other key groups, such as utility companies, trade and professional groups, who support the target market(s) served.

D. CRITICAL PATH PROJECT MILESTONES (MILESTONE PLAN/STATUS)

As a part of the approved SOPO, the Recipient will develop a Milestone Plan that will serve as the baseline for tracking performance of the project and will identify critical path project milestones (no less than 2 per calendar year) for the entire project.

During project performance, the Recipient will report the Milestone Status as part of the required quarterly Progress Report as prescribed under Attachment 4, Reporting Requirements Checklist. The Milestone Status will present actual performance in comparison with Milestone Plan, and include:

- (1) the **actual** status and progress of the project,
- (2) specific progress made toward achieving the project's critical path milestones, and,
- (3) any proposed changes in the projects schedule required to complete critical path milestones.

E. DELIVERABLES

The periodic, topical, and final reports shall be submitted in accordance with the attached "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist.

In addition, **for Program Areas of Interest 1 and 2 only**, successful applicants will design and develop an energy efficient, long-life laboratory device suitable to be a future product with cost in mind and deliver this to the NETL SSL project manager at the conclusion of the project.

[Note: The Recipient shall provide a list of deliverables other than those identified on the "Federal Assistance Reporting Checklist" that will be delivered. These reports shall also be identified within the text of the Statement of Project Objectives. See the following examples:

1. Task 1.1 - (Report Description)
2. Task 2.2 - (Report Description)

F. BRIEFINGS/TECHNICAL PRESENTATIONS (If applicable)

****The following Briefings/Technical Presentations apply ONLY to Program Areas of Interest 1 and 2.****

The Recipient shall prepare detailed briefings for presentation to the Project Officer at the Project Officer's facility located in Pittsburgh, PA or Morgantown, WV. Briefings shall be given by the Recipient to explain the plans, progress, and results of the technical effort.

The Recipient shall provide and present a technical paper(s) at the DOE/NETL Annual Contractor's Review Meeting to be held at the NETL facility located in Pittsburgh, PA or Morgantown, WV.

The Recipient shall provide and present a technical paper(s) at the DOE/NETL Peer Review Meeting to be held at DOE Headquarters in Washington D.C.; or other location specified by the DOE Project Officer.

****The following Briefings/Technical Presentations apply only to Program Area of Interest 3.****

The Recipient shall participate in SSL technical information meetings hosted by DOE (conference call or webcast).

[END OF STATEMENT OF PROJECT OBJECTIVES]

- ***Project Performance Site:***
Indicate the primary site where the work will be performed. If a portion of the work will be performed at any other sites, identify those sites, also.
- ***Biographical Sketch Appendix:***
Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in Section A on the R&R Budget form. Provide the biographical sketch information as an appendix to your project narrative. Do not attach a separate file. The biographical sketch appendix will not count in the project narrative page limitation. The biographical information for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point and must include:

Education and Training:

Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.

Research and Professional Experience:

Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

Publications.

Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically.

Patents, copyrights and software systems developed may be provided in addition to or substituted for publications.

Synergistic Activities.

List no more than 5 professional and scholarly activities related to the effort proposed.

Bibliography & References Cited (Field 8 on the form)

Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the application. In order to reduce the number of files attached to your application, please provide the Bibliography and References Cited information as an appendix to your project narrative. Do not attach a file in field 8. This appendix will not count in the project narrative page limitation.

Facilities & Other Resources (Field 9 on the form)

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. In order to reduce the number of files attached to your application, please provide the Facility and Other Resource information as an appendix to your project narrative. Do not attach a file in field 9. This appendix will not count in the project narrative page limitation.

Equipment (Field 10 on the form)

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. In order to reduce the number of files attached to your application, please provide the Equipment information as an appendix to your project

narrative. Do not attach a file in field 10. This appendix will not count in the project narrative page limitation.

Other Attachments (Field 11 on the form):

If you need to elaborate on your responses to questions 1-5 on the “Other Project Information” document, attach a file in field 11.

Also, attach the following files:

Commitment Letters from Third Parties Contributing to Cost Sharing

If a third party, (i.e., a party other than the organization submitting the application) proposes to provide all or part of the required cost sharing, the applicant must include a letter from the third party stating that it is committed to providing a specific minimum dollar amount of cost sharing. The letter should also identify the proposed cost sharing (e.g., cash, services, and/or property) to be contributed. Letters must be signed by the person authorized to commit the expenditure of funds by the entity and be provided in a PDF format. Save this information in a single file named “CLTP.pdf” and click on “Add Attachments” in Field 11 to attach.

Budget for DOE/NNSA Federally Funded Research and Development Center (FFRDC) Contractor, if applicable. If a DOE/NNSA FFRDC contractor is to perform a portion of the work, you must provide a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at <http://grants.pr.doe.gov>. Use the FFRDC name as the file name (up to 10 letters) and attach to the R&R Other Project Information form in Field 11 – Add Attachments.

3. RESEARCH AND RELATED BUDGET (TOTAL FED + NON-FED)

Complete the Research and Related Budget (Total Fed & Non-Fed) form in accordance with the instructions on the form (Activate Help Mode to see instructions) and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this announcement (See PART IV. G).

Budget Justification (Field K on the form).

Provide the required supporting information (See R&R instructions) for the following costs: equipment; domestic and foreign travel; participant/trainees; material and supplies; publication; consultant services; ADP/computer services; subaward/consortium/contractual; equipment or facility rental/user fees; alterations and renovations; and indirect cost type. Provide any other information you wish to submit to justify your budget request. If cost sharing is required, provide an explanation of the source, nature, amount, and availability of any

proposed cost sharing. Attach a single budget justification file for the entire project period in Field K. The file automatically carries over to each budget year.

4. R&R SUBAWARD (Total Fed + Non-Fed) FORM.

Budgets for Subawardees, other than DOE FFRDC Contractors. You must provide a separate cumulative R&R budget for each subawardee that is expected to perform work estimated to be more than \$100,000 or 50 percent of the total work effort (whichever is less). If you are selected for award, you must submit a multi-year budget for each of these subawardee (See Section IV.D for submission of Subawardees' multi-year budgets). Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET (Total Fed + Non-Fed) FORM and e-mail it to each subawardee that is required to submit a separate budget. Note: Subawardees must have installed PureEdge Viewer before they can complete the form. After the Subawardee has e-mailed its completed budget back to you, attach it to one of the blocks provided on the form. Use up to 10 letters of the subawardee's name (plus.xfd) as the file name (e.g., ucla.xfd or energyres.xfd).

5. Disclosure of Lobbying Activities (SF-LLL)

If applicable, complete SF- LLL. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

Summary of Required Forms/Files

Applications must include the following documents as applicable:

Name of Document	Format	Attach to
SF 424 (R&R)	PureEdge Form	N/A
RESEARCH AND RELATED Other Project Information	PureEdge Form	N/A
Project Summary/Abstract	PDF	Field 6
Project Narrative, including required appendices (Project Objectives, Merit Review Criterion Discussion, Statement of Project Objectives, Project Performance Site, Biographical Sketch Appendix, Bibliography & References Cited, Facilities & Other Resources, Equipment)	PDF	Field 7

Commitment Letters from Third Parties Contributing to Cost Sharing	PDF	Field 11
Budget for DOE/NNSA FFRDC, if applicable	PDF	Field 11
RESEARCH AND RELATED BUDGET (Total Fed + Non-Fed)	PureEdge Form	N/A
Budget Justification	PDF	Field K
R&R SUBAWARD BUDGET (Total Fed + Non-Fed), if applicable	PureEdge Form	N/A
SF-LLL Disclosure of Lobbying Activities, if applicable	PureEdge Form	N/A

D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS.

If selected for award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information
- Other budget information
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Commitment Letter from Third Parties Contributing to Cost Sharing, if applicable

E. SUBMISSION DATES AND TIMES.

1. Pre-application Due Date.

Pre-applications are not required.

2. Application Due Date.

Applications must be received by [September 12, 2006](#), not later than 8:00 PM Eastern Time. You are encouraged to transmit your application well before the deadline. APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.

F. GOVERNMENTAL REVIEW

- This program is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

G. FUNDING RESTRICTIONS.

Cost Principles Costs must be allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600.

Pre-award Costs Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR part 600. Recipients must obtain the prior approval of the contracting officer for any pre-award costs that are for periods greater than this 90 day calendar period.

Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the applicant expected.

H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit.

- **APPLICATIONS MUST BE SUBMITTED THROUGH GRANTS.GOV TO BE CONSIDERED FOR AWARD.** Submit electronic applications through the "Apply for Grants" function at www.Grants.gov. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to support@grants.gov.

2. Registration Process.

- You must COMPLETE the one-time registration process (all steps) before you can submit your first application through Grants.gov (See www.grants.gov/GetStarted). **We recommend that you start this process at least three weeks before the application due date.** It may take 21 days or more to complete the entire process. Use the Grants.gov Organizational Registration Checklists at <http://www.grants.gov/assets/OrganizationRegCheck.doc> to guide you through the process. **IMPORTANT:** During the CCR registration process, you will be asked to designate an E-Business Point of Contact (EBIZ POC). The EBIZ POC must obtain a special password called "Marketing Partner identification Number" (MPIN). When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e., Grants.gov registration).

3. Application Receipt Notices.

After an application is submitted, the Authorized Organization Representative (AOR) will receive a series of four e-mails. It is extremely important that the AOR watch for and save each of the emails. It may take up to two (2) business days from application submission to receipt of email Number 2. You will know that your application has reached DOE when the AOR receives email Number 4. You will need the Submission

Receipt Number (email Number 1) to track a submission. The titles of the four e-mails are:

- Number 1 - Grants.gov Submission Receipt Number
- Number 2 - Grants.gov Submission Validation Receipt for Application Number
- Number 3 - Grants.gov Grantor Agency Retrieval Receipt for Application Number
- Number 4 - Grants.gov Agency Tracking Number Assignment for Application Number
- Number 5 – DOE e-Center Grant Application Received

The last email will contain instructions for the AOR to register with the DOE e-Center. If the AOR is already registered with the DOE e-Center, the title of the last email changes to:

- Number 5 – DOE e-Center Grant Application Received and Matched

This email will contain the direct link to the application in IIPS. The AOR will need to enter their DOE e-Center user id and password to access the application.

Part V - APPLICATION REVIEW INFORMATION

A. CRITERIA.

1. Initial Review Criteria.

- Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for an award; (2) the information required by the announcement has been submitted; (3) all mandatory requirements are satisfied; and (4) the proposed project is responsive to the objectives of the funding opportunity announcement.

2. Merit Review Criteria.

Applications submitted in response to **Program Areas of Interest 1 or 2** within this funding opportunity will be evaluated and scored in accordance with the criteria and weights listed below:

1. Technical Merit (Criterion 1) – 40%

- Demonstrated validity of the product's potential to fill the proposed need or problem, ability to address key risks, and technical superiority over currently available products.
- Soundness of the proposed approach and the likelihood to impact and have success in the marketplace.
- Comprehensiveness and feasibility of the Statement of Project Objectives (SOPO) including the proposed technical milestones for each interval of the proposed effort with special emphasis on the descriptive, qualitative and especially quantitative, where applicable, milestone aspects. Technical realism and likelihood of success of the proposed technical milestones and deliverables for each interval of the effort.
- Feasibility of proposed work, the scientific merit, and the proposed technical innovation.

2. Applicant and Participant Roles and Capabilities (Criterion 2) – 25%

- Demonstrated success of project management on previous programs, Federal or non-Federal. Evidence of current corporate experience and success in similar projects which led to successful technology development and commercialization or technology transfer to commercial product(s).
- Demonstration of experience and availability of key personnel to complete the proposed project, including personnel involved in technical, commercialization and/or technology transfer.
- Reasonableness of the proposed labor hours, categories proposed for the work plan and the subcontracting effort description and need.

- Adequacy (quality, availability and appropriateness) of proposed/identified facilities and equipment to accommodate the proposed project.

3. Industrial Involvement and Commercialization Potential (Criterion 3) – 25%

- Completeness of the commercialization strategy for the proposed technology or product and of the intellectual property rights. Evidence of involvement from business sectors and/or institutional alliances and the ability to successfully execute the commercialization strategy.
- Degree to which discussion of the viability and practicality of the proposed technology, product or information demonstrates ability to meet the needs of the target market in a cost effective manner without major market restructuring considering potential technical, regulatory, economic, environmental, production or other issues impacting market success. Reasonableness of the explanation of any variation from the price and performance projections outlined in Part I of this Announcement (reference Tables/Figures 1.1 or 1.2).
- Evidence of organizational commitment to manufacture the proposed technology or product substantially in the United States.

4. Energy, Environmental, and Economic Benefits (Criterion 4) – 10%

- The legitimacy and impact of the energy benefits calculated using the “Guide for Evaluation of Energy Savings Potential – Solid State Lighting Research and Development” contained in Appendix C to this Announcement.
- The legitimacy and impact of the environmental benefits which include, but are not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability, beneficial human health impacts and potential reductions in emissions of carbon dioxide from the proposed technology according to the guidelines contained in Appendix C, “Guide for Evaluation of Energy Savings Potential – Solid State Lighting Research and Development,” to this Announcement.

Applications submitted in response to **Program Area of Interest 3** within this funding opportunity will be evaluated and scored in accordance with the criteria and weights listed below:

1. Technical Merit (Criterion 1) - 30%

- The clarity, completeness and feasibility of the proposed Statement of Project Objectives (SOPO).
- The potential to deliver the described outcomes and results (influence key target market(s) with SSL technical information).

- Appropriateness of proposed project approach for packaging and distributing SSL technical information from DOE to key target markets served by the applicant and the validity and merit of the proposed approach.
- The level of interaction and outreach with proposed key target markets of interest to DOE (electric utility companies, market transformation organizations, State and local energy offices etc.).

2. Schedule (Criterion 2) - 30%

- Legitimacy of the proposed work schedule including the proposed deliverables and anticipated due dates.
- Effectiveness of the proposed timeline or Gantt chart to complete project objectives.

3. Applicant and Team Member Roles and Capabilities (Criterion 3) - 40%

- Adequacy of the proposed team's abilities to achieve the goals stated in the Statement of Project Objectives (SOPO); the level of professional credentials and experience in developing energy technical information products for one or more of the key target market(s).
- Demonstrated success of project management on previous programs, Federal or non-Federal.
- Reasonableness of time allocations outlined in the manpower matrix; effectiveness of the proposed roles and responsibilities of outlined personnel.
- Degree of experience with the typical technical information needs of electric utilities, market transformation organizations, State and local energy offices that operate energy efficiency programs.
- The adequacy (quality, availability, and appropriateness) of proposed facilities and equipment to accommodate the proposed project.

3. Other Selection Factors.

- The selection official will consider the following program policy factors in the selection process:

These factors, while not indicators of the application's merit, e.g., technical excellence, cost, Applicant's ability, etc., may be essential to the process of selecting the application(s) that, individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Applicants should recognize that some very good applications may not receive an award because they do not fit within a mix of projects which maximizes the probability of achieving the DOE's overall R&D objectives. Therefore, the following Program Policy Factors may be used by the

Selection Official to assist in determining which of the ranked application(s) shall receive DOE funding support.

1. It may be desirable to select for award a group of projects which represents a diversity of technical approaches and methods;
2. It may be desirable to select complementary and/or duplicative efforts or projects, which, when taken together, will best achieve the research goals and objectives;
3. It may be desirable to select different kinds and sizes of organizations in order to provide a balanced programmatic effort and a variety of different technical perspectives;
4. It may be desirable, because of the nature of the energy source, the type of projects envisioned, or limitations of past efforts, to select a group of projects with a broad or specific geographic distribution.
5. It may be desirable to select project(s) of less technical merit than other project(s) if such a selection will optimize use of available funds by allowing more projects to be supported and not be detrimental to the overall objectives of the program.
6. It may be desirable to select project(s) that reduce Federal investment and maximize corporate commitment as demonstrated by cost share levels that exceed the required 20%.

B. REVIEW AND SELECTION PROCESS.

1. Merit Review.

- Applications that pass the initial review will be subjected to a merit review in accordance with the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance and Unsolicited Proposals." This guide is available under Financial Assistance, Regulations and Guidance at <http://professionals.pr.doe.gov/ma5/ma-5web.nsf/?Open>.

2. Selection.

- The Selection Official will consider the merit review recommendation, program policy factors, and the amount of funds available.

3. Discussions and Award.

- The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with the requirements in 10 CFR part 600; and/or (4) special

terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES.

- DOE anticipates notifying applicants selected for award by November 2006 and making awards by the end of January 2007.

Part VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES.

1. Notice of Selection.

- DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance. (See Part IV.F with respect to the allowability of pre-award costs.)

Organizations whose applications have not been selected will be advised as promptly as possible. This notice will explain why the application was not selected.

2. Notice of Award.

- A Notice of Financial Assistance Award issued by the contracting officer is the authorizing award document. It normally includes either as an attachment or by reference: (1). Special Terms and Conditions; (2). Applicable program regulations, if any; (3). Application as approved by DOE/NNSA.; (4). DOE assistance regulations at 10 CFR part 600, or, for Federal Demonstration Partnership (FDP) institutions, the FDP terms and conditions; (5). National Policy Assurances To Be Incorporated As Award Terms; (6). Budget Summary; and (7). Federal Assistance Reporting Checklist, which identifies the reporting requirements.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS.

1. Administrative Requirements.

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR part 600 (See: <http://ecfr.gpoaccess.gov>), except for grants made to Federal Demonstration Partnership (FDP) institutions. The FDP terms and conditions and DOE FDP agency specific terms and conditions are located on the National Science Foundation web site at http://www.nsf.gov/awards/managing/fed_dem_part.jsp.

2. Special Terms and Conditions and National Policy Requirements.

Special Terms and Conditions and National Policy Requirements.

The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at <http://grants.pr.doe.gov>. The National Policy Assurances To Be Incorporated As Award Terms are located at <http://grants.pr.doe.gov>.

Intellectual Property Provisions.

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at http://www.gc.doe.gov/techtrans/sipp_matrix.html.

Statement of Substantial Involvement.

This statement may be modified to fit specific projects.

RECIPIENT'S RESPONSIBILITIES. The Recipient is responsible for:

Performing the activities supported by this award, including providing the required personnel, facilities, equipment, supplies and services;

Defining approaches and plans, submitting the plans to DOE for review, and incorporating DOE comments;

Managing and conducting the project activities;

Providing all deliverables specified in the award in a timely basis;

Participating in all briefings specified in the award Statement of Project Objectives;

Submitting technical reports and incorporating DOE comments; and;

Presenting the project results at appropriate technical conferences or meetings as directed by the DOE Project Officer.

DOE RESPONSIBILITIES. DOE is responsible for:

Reviewing in a timely manner project plans and recommends alternative approaches if the plans do not address critical programmatic issues;

Monitoring to recommend alternative approaches to the work because of interrelationships with other projects.

Reviewing in a timely manner, technical reports and other deliverables and providing comments to the Recipient;

Conducting program review meetings to ensure adequate progress and that the work accomplishes the program and project objectives. Recommend alternative approaches to the work or shifting work emphasis, if needed;

Promoting and facilitating technology transfer activities, including disseminating program results through presentations and publications;

Serving as scientific/technical liaison between awardees and other program or industry staff; and

(Applicable to Program Areas of Interest 1 and 2 only)** Collaborate with recipient in the development of a test plan; in an effort to enhance performance monitoring capabilities, NETL will establish a set of measurement guidelines that will allow reliable and consistent performance monitoring data between SSL research activities.

C. REPORTING.

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. See the NETL Business Page at <http://www.netl.doe.gov/business/forms/FederalAssistanceReportingChecklistExample> for the proposed Checklist for this program.

PART VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS.

Questions regarding the content of the announcement must be submitted through the “Submit Question” feature of the DOE Industry Interactive Procurement System (IIPS) at <http://e-center.doe.gov>. Locate the program announcement on IIPS and then click on the “Submit Question” button. Enter required information. You will receive an electronic notification that your question has been answered. DOE will try to respond to a question within three (3) business days, unless a similar question and answer have already been posted on the website.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. DOE cannot answer these questions.

B. AGENCY CONTACT.

Name: Kelly A. McDonald
E-mail: kelly.mcdonald@netl.doe.gov

PART VIII - OTHER INFORMATION

A. MODIFICATIONS.

Notices of any modifications to this announcement will be posted on Grants.gov and the DOE Industry Interactive Procurement System (IIPS). You can receive an email when a modification or an announcement message is posted by joining the mailing list for this announcement through the link in IIPS. When you download the application at Grants.gov, you can also register to receive notifications of changes through Grants.gov.

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE.

DOE reserves the right, without qualification, to reject any or all applications received in response to this announcement and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. COMMITMENT OF PUBLIC FUNDS.

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

D. PROPRIETARY APPLICATION INFORMATION.

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

“The data contained in pages _____ of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the government’s right to use or disclose data obtained without restriction from any source, including the applicant.”

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

“The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation.”

E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL.

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel

to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM.

Patent Rights. The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See "Notice of Right to Request Patent Waiver" in paragraph G below.)

Rights in Technical Data. Normally, the government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE's own needs or to insure the commercialization of technology developed under a DOE agreement.

G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER.

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this announcement, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

H. NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES.

Eligible activities under this program include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

I. EXCEPTIONAL CIRCUMSTANCES.

This article is applicable to Program Areas of Interest 1 and 2 only:

The Exceptional Circumstances Determination for the Solid State Lighting Program ([http://www.netl.doe.gov/ssl/PDFs/SSL_Determination - Signed June 2005_1.pdf](http://www.netl.doe.gov/ssl/PDFs/SSL_Determination_-_Signed_June_2005_1.pdf)) imposes a United States manufacture requirement on the recipients of SSL Product Development cooperative agreements resulting from this Announcement. Specifically, the Determination requires that any entity having the right to use or sell any subject invention under one of the cooperative agreements in the United States and/or any other country -including the product developer--must agree that any products embodying the subject invention or produced through the use of the subject invention will be substantially manufactured in the United States. Any waiver of this requirement must be approved in writing by the Department of Energy in advance of foreign manufacture.

APPENDICES/REFERENCE MATERIAL

- [Appendix A - PRODUCT DESCRIPTION](#)
- [Appendix B - CURRENT AND TARGET SYSTEM EFFICIENCIES](#)
- [Appendix C - GUIDE FOR EVALUATION OF ENERGY SAVINGS POTENTIAL – SOLID STATE LIGHTING RESEARCH AND DEVELOPMENT](#)
- [Appendix D - CHECKLIST ITEM SUGGESTIONS FOR PROGRAM AREAS OF INTEREST 1 AND 2](#)

APPENDIX A – PRODUCT DESCRIPTION

Projects that offer and demonstrate a logical path to achieving the highest energy savings have a greater probability of being selected. This means *realized* energy savings that would result from the manufacture and sale of a significant number of the product. Applicants may use commercially available devices in combination with advanced optical and thermal solutions to achieve the targeted efficiency gains. However, this product concept should exhibit significant performance and/or cost advantages over the commercial purchased components. Since this is a product development solicitation, applicants should submit a contemplated product description (data sheet). Table 1.0 is an example format to show proposed performance goals and product specifications (need not follow exactly). Applicants must propose products that exceed current SSL technology and surpass performance levels in conventional lighting.

DATA SHEET TEMPLATE	
Describe the product in general. Physical size, layout, etc. LED or OLED – indicate whether the product includes commercial devices, is a modification of a commercial device, or is a new LED or OLED development.	Datasheet
	<ul style="list-style-type: none"> • Wavelength(s) of emitting device(s) • CCT (K) • CRI • I (mA) vs. V (Volts) curve at $T_a = 25^{\circ}\text{C}$ under normal operating conditions. • Radiant Flux (lm) vs. I (mA) at $T_a = 25^{\circ}\text{C}$ • Viewing Angle • Maximum forward voltage at a specified current. • Maximum Operating Temperature • Minimum Operating Temperature • Maximum DC Forward Current
Driver	Efficiency (%)
Fixture and optics of the luminaire	Efficiency (%)

Table 1.0 Example Product Description

APPENDIX B – CURRENT AND TARGET SYSTEM EFFICIENCIES

The applicant should identify “breakthrough” solutions which will result in a lighting system product that is superior to current competing products or technologies with significant energy savings that take into account losses in the driver or optical system as well as light emitting device performance.

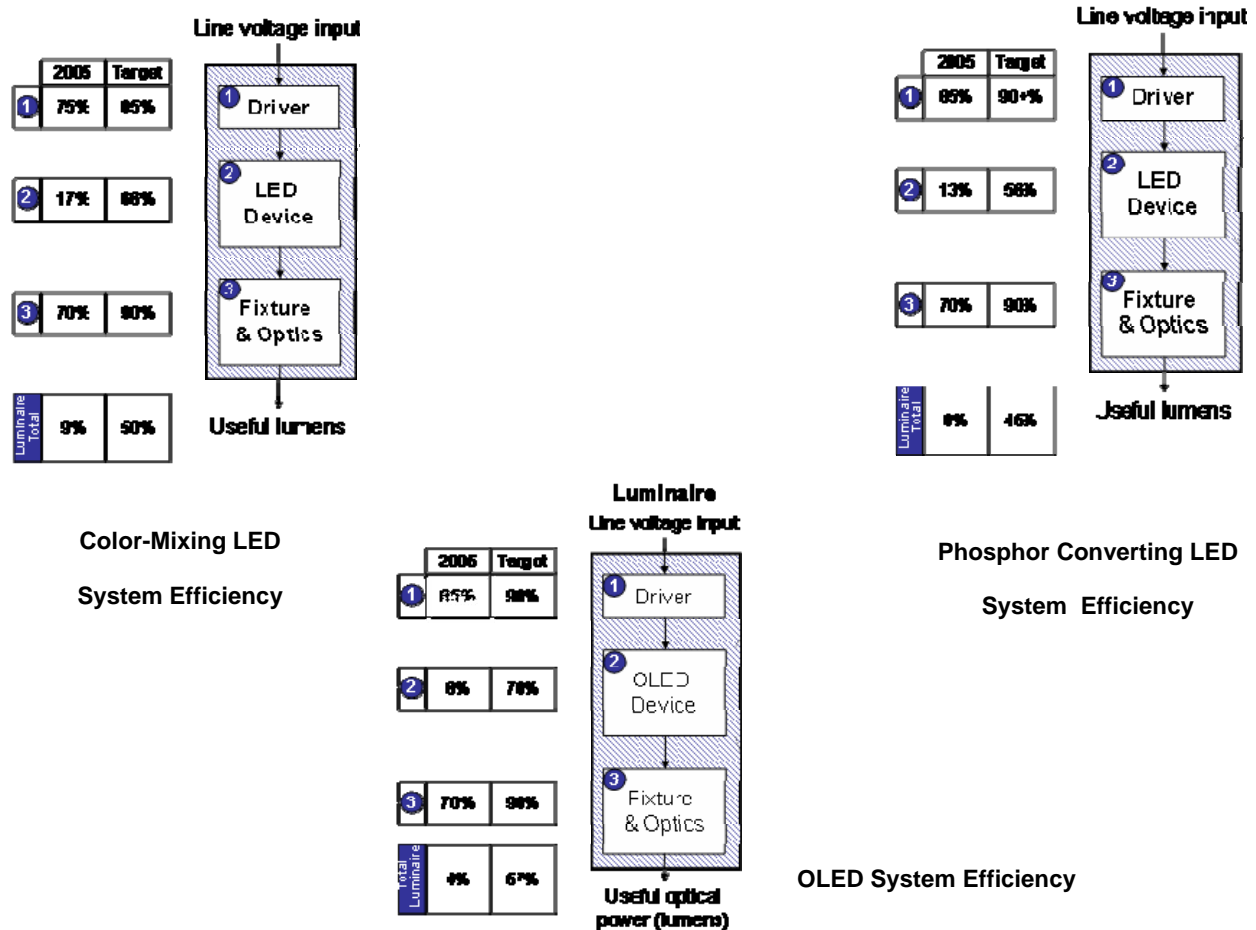


Figure 1.0 Current and Target System Efficiencies

Figure 1.0 presents a diagram of three different luminaires namely Color-Mixed LED, Phosphor Converted LED and a OLED system. The percentage efficiencies in the diagram next to each component indicate the typical performance in 2005 and suggested targets that will satisfy the goals of the program. In other words, this diagram depicts the areas for improvement. For purposes of comparing various experimental results, the LED luminaire in this diagram is assumed to have a correlated color temperature target of 4100°K (the equivalent CCT of a cool white fluorescent lamp), and a CRI of at least 80. The OLED luminaire in this diagram is assumed to have a CCT of 3000-6000K, CRI of at least 80 and a brightness of 1,000 cd/m². Other combinations may provide acceptable light for particular market needs.

Successful applications will propose luminaires with improved system efficiencies illustrated in

the above Figure 1.0, e.g., a color-mixing LED system efficiency of 50%.

**Appendix C – GUIDE FOR EVALUATION OF ENERGY SAVINGS POTENTIAL
– SOLID STATE LIGHTING RESEARCH AND DEVELOPMENT**

GUIDE FOR EVALUATION OF ENERGY SAVINGS POTENTIAL

SOLID STATE LIGHTING RESEARCH AND DEVELOPMENT

Office of Energy Efficiency and Renewable Energy

Building Technologies Program

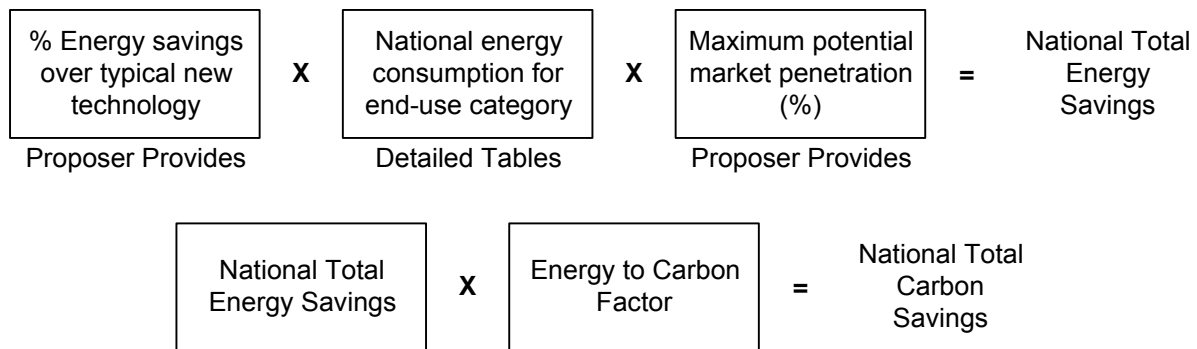
April 2, 2004

Introduction

This guide provides a method for estimating the savings in primary energy consumption and carbon emissions that could result from projects in solid state lighting research and development (SSLR&D). The objective of creating this standardized estimation method is to facilitate comparison of a wide variety of SSLR&D applications on an equitable basis. This guide provides a simple calculation framework and some of the constants and baseline energy estimates to use for that calculation.

The method is applicable to lighting technologies for both residential and commercial buildings. The method can accommodate lighting technologies that are at the very early stages of development as well as well-characterized technologies in the midst of a development cycle. It may not provide an accurate forecast of the likely impact of any one specific technology, however, by creating a consistent framework for analysis, the method will enable comparability amongst applications.

The savings estimates are expressed in terms of an annual national energy savings rate, based on the maximum likely market penetration of the proposed technology. A straightforward calculation method accommodating most technologies and markets is illustrated below:



The method requires four basic data items to generate an estimate of both primary energy savings and carbon emission savings. Those items and their sources are:

Item #	Description	Source
1	Primary energy consumption of the end use(s) targeted	Attached tables A and B
2	Performance level of typical new lighting technology	Attached tables A and B
3	Performance level of proposed technology	Proposer provides and substantiates
4	Expected market penetration of proposed technology	Proposer provides and substantiates

Items 1 and 2 are provided by the Department in Tables A and B, covering residential and commercial installations, respectively. Table C provides data to convert energy savings into carbon emissions savings, along with selected conversion constants, to ensure consistency among the estimates. Items 3 and 4 are provided by the proposer and must have adequate supporting justification for the performance and expected market penetration.

The performance level (item 3) must be based on the attributes of the proposed technology and must be substantiated by appropriately detailed engineering or scientific analysis, simulation modeling, and/or literature references. Substantiating data are necessary to justify the performance level used. In some cases, the lighting technology proposed will be a sub-component of one of the elements listed in Tables A and B. Sub-component technologies will require some additional calculations to adjust baseline energy before applying the methodology. Example #2 deals with this situation. The methodology should be based on comparing the performance level of the proposed technology with the performance of the typical new technology currently used. In a replacement situation, it is implicitly assumed that replacement would occur regardless of the new technology. Therefore, the comparison is not based on the performance of the technology actually being replaced, but on the technology most likely to be used today.

The expected market penetration (item 4) is an estimate of the long-term penetration of the target market, on a percentage basis. The expected market penetration must be supported by a brief market analysis and/or supporting literature references. The brief market analysis must consider sector-specific economic factors (including expected first cost and payback period, relative to other technologies) and non-economic factors, which may limit the penetration of all of the target markets. (Non-economic factors include product physical size, building characteristics and institutional barriers.) A discussion of these factors may be necessary to justify the market penetration level used. It is possible to save energy with a technology that does not exceed the maximum efficiency available in the market, if the proposed technology has a lower first cost. The low-cost technology could create an incremental or additional market penetration above the present sales level for highly efficient products. This incremental market penetration would be used in calculating savings.

The savings calculation method outlined herein, if applied directly, may not accurately estimate the savings for certain technologies (such as crosscutting, integrated technologies) or niche applications. For these special cases, the proposer may modify this methodology or create a comparable methodology, as long as the methodology provides an equivalent level of calculation transparency, contains adequate justification through supporting data, and is fully consistent with the data in Tables A through C. The savings should be presented in terms of an annual national rate at maximum market penetration, not cumulative savings over several years nor a savings rate at some future point in time.

Lighting Technologies

The approach for estimating the relative energy savings of lighting technologies is based on the on-going replacement of lighting equipment in the existing building stock. The current energy consumption characteristics of existing buildings (Tables A and B) are used as the baseline for market penetration and savings estimates. This method implicitly uses the following approximations:

- all lighting equipment in all current buildings will eventually be replaced with new equipment, either due to equipment failure, functional, or economic factors.
- over the next 20 years, replacement of lighting equipment in existing buildings will produce a much larger market for energy savings than installations in newly-constructed buildings.

Therefore, there is no need to attempt to forecast the energy consumption characteristics of building lighting equipment in the future. Nor is there a need to calculate energy savings potential in new construction. Sufficient differentiation with respect to energy savings potential can be determined using the energy use characteristics of existing buildings.

Example #1: This example deals with the development of a white-light LED designed to replace incandescent reflector lamps. The target market is both residential and commercial buildings. For the expected market penetration, the proposer estimates that 60% of the installed base of reflector lamps have the potential of being replaced by this new technology. This penetration level reflects the influence of several factors, including: the cost of electricity, the higher cost associated with this new technology, the sector-specific paybacks associated with this cost, and the number of applications into which it may be installed.

Example #2: This example considers the development of a white-light OLED device that is capable of replacing fluorescent lighting systems in commercial buildings. This is a system-to-system comparison, where a fluorescent system is replaced with an OLED fixture. The expected market penetration is 50% of the installed base, reflective of factors such as the operating and maintenance cost savings, and the sector-specific payback periods associated with the retail price of this product.

Example 1. White-Light LED Replacement for Incandescent

A newly developed, high-brightness, energy efficient, white-light LED is proposed to replace incandescent reflector lamps. From detailed engineering models based on laboratory results, the performance of these LEDs has been determined to be 75 lumens per watt. From market analyses, the maximum expected market penetration is 60% of the installed reflector lamp stock, limited primarily by the higher cost associated with this new technology, the sector-specific paybacks resulting from the energy savings, and the number of applications into which it may be installed. The efficacy and market penetration estimates were prepared by the proposer and have supporting documentation and data.

Step 1: Enter the efficacy of the proposed new white-light LED into two of the boxes. Look up the typical efficiency of a typical new reflector lamp in Table A⁶ – 11 lumens per watt; this value is entered into the second box. Simple arithmetic provides the percent energy savings over a typical new reflector lamp as 85%.

⁶ Tables A through C are located at the end of Section V.

Efficacy of Proposed New LED	-	Efficacy of Typical New Reflector Lamp		\div	Efficacy of Proposed New LED	x 100 =	%Energy Savings Over Typical New Technology
Proposer Provides		Table A			Proposer Provides		

75 LPW	-	11 LPW		\div	75 LPW	x 100 =	85%
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Step 2: This technology is applicable to reflector lamp applications in both the residential and commercial sectors. Look up the energy consumption of reflector lamps in tables A and B: the residential sector consumes 0.2540 quads and the commercial sector consumes 0.3225 quads. In total then, the installed base of incandescent reflector lamps is estimated to consume approximately 0.5765 quads each year.

Step 3: Provide the value of the potential market penetration, estimated by the proposer. The estimate provided is 60%.

Step 4: Place the three values (85%, 0.5765 quads, and 60%) into the energy savings estimate equation boxes and multiply. The result is a national total annual energy savings of 0.294 quads due to this new, more energy efficient lighting technology.

% Energy savings over typical new technology	x	National energy consumption for end-use category	x	Maximum potential Market penetration (percent)	=	National Total Energy Savings
Calculated, Step 1		Tables A & B		Proposer Provides		

85%	x	0.5765	x	60%	=	0.294 Quads
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Step 5: To obtain the related carbon savings for the 0.294 quads, look up in Table C, the fuel-specific carbon emissions factor. The conversion value is 16.33 MMTC/quad (million metric tonnes carbon per quadrillion Btu). Insert the two values into the boxes, and multiply the energy savings by the conversion factor. The result is 4.80 million metric tonnes of carbon (MMTC) saved annually due to this new, energy efficient lighting technology.

National Total Energy Savings	X	Energy to Carbon Factor	=	National Total Carbon Emission Savings
0.294 quads	X	16.33 MMTC/quad	=	4.80 MMTC

Example 2. OLED Replacement for Fluorescent Lighting Fixture

This example considers the development of a white-light OLED device that is capable of replacing fluorescent lighting systems in commercial buildings. This is an example of a system-to-system comparison, whereby a fluorescent fixture is replaced by a new fixture incorporating an OLED device. A fluorescent system efficacy is estimated in Table B to be approximately 54 lumens per watt, adjusting the fluorescent lamp efficacy for an assumed 80% fixture efficiency and an 85% ballast efficiency. The expected market penetration of this device is 20% of the installed base, reflective of factors such as the first cost, operating and maintenance cost savings, and the sector-specific payback periods. Proposer must provide supporting documentation and/or data on the estimate of penetration.

Step 1: From modeling and/or measurements of a white-light OLED device, the proposer establishes that the product has a system efficacy of 60 lumens per watt. Convert that performance into a % energy savings over typical new fluorescent systems. Compared to a typical new fluorescent system of 54 lumens per watt, the proposed OLED is 10% more efficient.

Efficacy of Proposed New OLED	-	Typical New Fluorescent System Efficacy	÷	Efficacy of Proposed New OLED	x 100	=	%Energy Savings Over Typical New Technology
Proposer Provides		Table B		Proposer Provides			

60 LPW	-	54 LPW	÷	60 LPW	x 100	=	10%
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Step 2: Look up the energy consumption attributable to fluorescent lighting in Table B. The value is 2.23 quads, which accounts for all linear fluorescent lighting systems in commercial buildings.

Step 3: The proposer estimates the level of anticipated market penetration for the OLED system, estimated and substantiated by the proposer. The estimate provided is 20%.

Step 4: Place the above three values (10%, 2.23 quads, and 20%) into the provided boxes and multiply. The result is a national total energy savings of 0.045 quads.

% Energy savings over typical new technology	X	National energy consumption for end-use category	X	Maximum potential Market penetration (percent)	=	National Total Energy Savings
Calculated, Step 1		Tables A & B		Proposer Provides		
10%	X	2.23	X	20%	=	0.045 Quads

Step 5: To obtain the related carbon emission savings for the 0.045 quads, look up the appropriate generic carbon emissions factor in Table C. The conversion value is 16.33 MMTC/quad (million metric tonnes of carbon per quad of primary energy). Insert the two values into the boxes, and multiply the energy savings by the conversion factor. The result is a 0.73 million metric tonne reduction of carbon emissions.

National Total Energy Savings	X	Energy to Carbon Factor	=	National Total Carbon Savings
0.045 quads	X	16.33 MMTC/quad	=	0.73 MMTC

INPUT TABLES

Table A: Residential End-Use Primary Energy Consumption and Typical Efficiencies

Type of Lighting	Total Energy Use (quads) ⁷	Typical New Source Efficacy (lumens per watt) ⁸	Typical New System Efficacy (lumens per watt) ⁹
Incandescent General Service	1.7054	15	12
Incandescent Reflector	0.2540	11	9
Halogen Lamps	0.0609	20	16
Fluorescent Lamps (excluding CFL)	0.2026	65	44
Compact Fluorescent Lamp	0.0115	55	37
Mercury Vapor	0.0061	40	22
High Pressure Sodium	0.0010	80	45

⁷ Quads of energy, accounting for the primary energy consumed at the generating power plant, incorporating all the generation, transmission and distribution losses associated with the delivery of electricity to the light fixture on site.

⁸ Efficacy (lumen per watt) values will vary by wattage within a given lamp type. Constant values are proposed for the energy savings calculation for comparability of applications.

⁹ System efficacy represents the performance of the lamp, fixture and ballast/transformer (if necessary). Low voltage halogen transformers are assumed to be 90% efficient, fluorescent ballasts are assumed to be 85%, and HID ballasts are assumed to be 70%. For comparability of applications, fixture efficiency for all sources is assumed to be 80%, however the Department recognizes that fixture efficiencies vary with fixture size, shape, treatment, and application. For example, compact fluorescent lamps have typical luminaire efficiencies in the range of 30% to 70%, while luminaires using incandescent reflector lamps have efficiencies from 65% to more than 90%.

Table B: Commercial End-Use Primary Energy Consumption and Typical Efficiencies

Type of Lighting	Total Energy Use (quads) ²	Typical New Source Efficacy (lumens per watt) ³	Typical New System Efficacy (lumens per watt) ⁴
Incandescent General Service	0.7497	15	12
Incandescent Reflector	0.3225	11	9
Halogen Lamps	0.1504	20	16
Halogen Reflector, Low Voltage	0.0779	13	9
Misc. Incandescent Low Wattage	0.0405	10	8
Fluorescent Linear Tube	2.2297	80	54
Compact Fluorescent Lamp	0.1054	60	41
Circline and Misc. Fluorescent	0.0347	60	41
Mercury Vapor	0.0703	50	28
Metal Halide	0.3648	70	39
High Pressure Sodium	0.0608	100	56
Low Pressure Sodium	0.0014	140	78

Table C: Electricity Prices and Conversion Factors

Item	Value	Units
Residential Electricity Price (2002)	0.084	\$/kWh
Commercial Electricity Price (2002)	0.079	\$/kWh
Fuel Specific Carbon Emission Factors		
Electricity (2001)	16.33	Million metric tonnes carbon per quad
Average delivered Utility Power (2001)	11,030	BTU/kWh

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**Appendix D – CHECKLIST ITEM SUGGESTIONS FOR PROGRAM AREAS
OF INTEREST 1 AND 2**

Checklist item suggestions:

Technical merit

- ✓ The proposed “product” has been clearly described
- ✓ “Proof of concept” for the technology or product already exists
- ✓ The specific application(s) and customer(s) have been clearly stated
- ✓ Customer needs have been identified
- ✓ Competing available products or technologies have been identified
- ✓ Milestones are appropriate for the development
- ✓ The timing of milestones is appropriate for planned reviews

Roles and capabilities

- ✓ Appropriate resources are available and assigned to the project
- ✓ Provided evidence that the project and goals are within the expertise of the assigned team
- ✓ Any need for partnering to supplement team experience has been identified and discussed

Commercialization

- ✓ Have clearly identified the distribution channel for the product to the target customers
- ✓ Have shown that the product can be developed at the cost for the market
- ✓ Competing technologies or products have been identified and addressed
- ✓ Appropriate partners for the commercialization strategy have been identified (if needed)
- ✓ Evidence of management support for commercialization and substantial U.S. manufacture is provided

Benefits

- ✓ The calculated benefits are specific to the product, market segments, and performance to be reached under this proposal